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OPERATING INSTRUCTIONS

TYPE 1021-AW
STANDARD-SIGNAL GENERATOR

. . . . SINCE 1915
manufacturers of
electronic apparatus
for science and industry

GENERAL RADIO COMPANY
CAMBRIDGE 39, MASSACHUSETTS, USA

OPERATING AND MAINTENANCE INSTRUCTIONS

TYPE 1021-AW STANDARD-SIGNAL GENERATOR

Form 911-B
April, 1956

GENERAL RADIO COMPANY

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Printed in U.S.A.

SPECIFICATIONS

FREQUENCY RANGE	900 to 2000 Mc.
CIRCUIT	Grid separation triode oscillator. Line sections with sliding-contact shorts are used to tune plate and cathode.
FREQUENCY CONTROL	A 6-in. dial with direct-reading frequency calibration over 200°. Slow-motion drive, 8 turns.
FREQUENCY CALIBRATION ACCURACY	±1%.
FREQUENCY DRIFT	Approximately 0.1% during warm-up.
OUTPUT VOLTAGE	Continuously adjustable from 0.5μv to 0.7 volt open circuit.
OUTPUT IMPEDANCE	50 ohms ± 10%
OUTPUT VOLTAGE ACCURACY	Better than ± 20%, over-all.
MODULATION	Square-wave modulation from 100 to 5000 cycles is possible with an external modulator with 30 volts peak to peak and 2500-ohm internal impedance.
LEAKAGE	Stray fields and residual output voltage will not affect tests with a receiver having 2-μv sensitivity.
TERMINALS	Type 874 Coaxial terminals provided.
POWER SUPPLY	115 or 230 volts, 50 to 60 cycles, power input approximately 50 watts.
TUBES	One Type 5675 u-h-f medium-mu triode (pencil tube) in Type 1021-P4 U-H-F Unit; one each Type 6X5GT, 6K6GT, and Amperite 6-4, and two Type 0C3 in Type 1021-P1 Power Supply.
ACCESSORIES SUPPLIED	Type 874-R22 3-ft. Patch Cord (50 ohms); Type 874-C58 Coaxial Cable Connector; Type 874-PB58 Panel Connector; Type CAP-35 Power Cord; Telephone Plug.
ACCESSORIES AVAILABLE (Recommended for 100-percent amplitude modulation and for pulsing)	Type 874-G20 20-db Attenuator Pad; Type 874-G10 10-db Attenuator Pad; Type 874-K Coupling Capacitor; Type 1000-P7 Balanced Modulator.
MOUNTING	Aluminum cabinet has black-wrinkle finish. Left-hand side houses Type 1021-P1 Power Supply; right-hand side houses Type 1021-P4 U-H-F Unit. Panels are black-crackle-finished aluminum.
DIMENSIONS	Height 14-3/8 in.; width 20-1/4 in.; depth 10-5/8 in., over-all.
NET WEIGHT	37-1/2 lb

U. S. Patent No. 2,548,457

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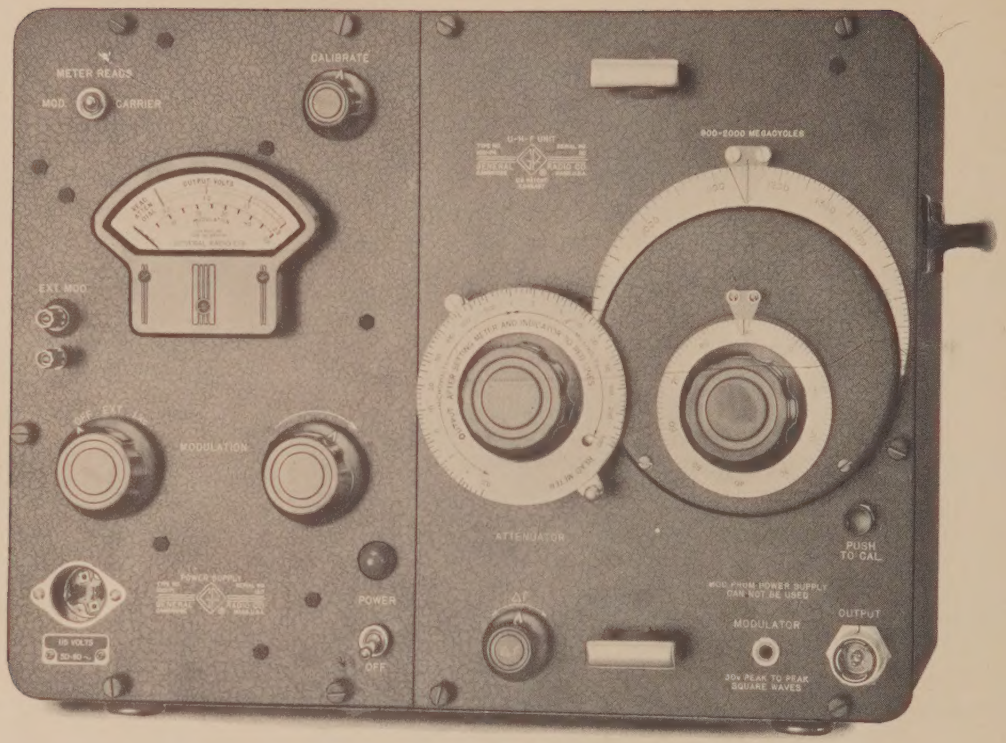

Figure 1. Type 1021-AW Standard-Signal Generator.

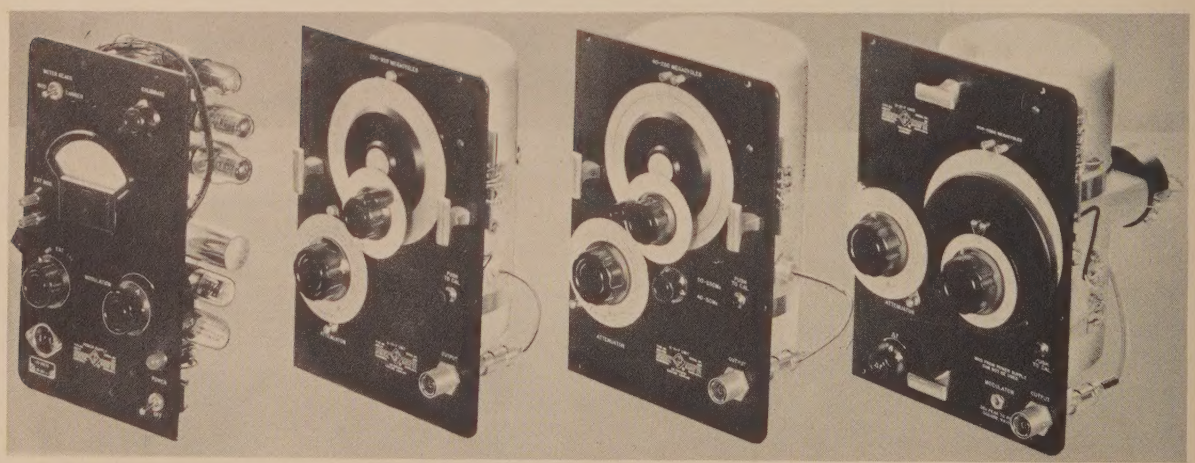

Figure 2. The Four Units of the Type 1021 Series of Signal Generators.

TYPE 1021-AW

STANDARD-SIGNAL GENERATOR

Section 1

INTRODUCTION

1.1 GENERAL.

1.1.1 THE FOUR UNITS OF THE TYPE 1021 STANDARD-SIGNAL GENERATOR. The Type 1021-AW Standard-Signal Generator operates in the frequency range of 900-2000 Mc. The assembly consists of the Type 1021-P1 Power Supply and the Type 1021-P4 U-H-F Unit, mounted in a common cabinet. (See Figure 1.) The power supply and the cabinet are the same as those used on two lower-frequency signal generators, the Type 1021-AV V-H-F Standard-Signal Generator (for 40-250 Mc) and the Type 1021-AU U-H-F Standard-Signal Generator (for 250-920 Mc).

If two or three radio-frequency units are available with only one cabinet and power supply, one unit can easily replace the other. The only connections between the power supply and the r-f section are made by a multiconductor cable and plug, attached permanently to the power supply, and an additional single lead, permanently attached to the Type 1021-P4 U-H-F Unit for 900-2000 Mc. The other two r-f units do not require the additional lead. The four parts of the Type 1021 series Standard-Signal Generator are shown in Figure 2.

1.2 DESCRIPTION.

1.2.1 GENERAL. The block diagram (Figure 3) shows the functional arrangement of the Standard-Signal Generator. The upper part of the diagram represents the r-f section and the lower part the power supply.

The operating frequency is set by the six-inch main dial of the carrier oscillator. Small changes in frequency are made with the Δf control.

The output voltage is controlled by the ATTENUATOR dial on the front panel. High output voltages are indicated directly on the CARRIER meter in the power supply. The carrier meter is energized by the voltmeter-rectifier in the r-f section. Low output voltages are set by the ATTENUATOR dial after a reference level is established at 0.5 volt by means of the CARRIER meter.

The output impedance is determined by a 50-ohm resistor between the voltmeter-rectifier and the output terminal on the front panel.

Unlike the two lower-frequency generators, which are amplitude-modulated by sinusoidal voltages, the high-frequency unit is designed for square-wave modulation from an external source. Square-wave modulation, which eliminates incidental frequency modulation, has many advantages in high-frequency measurements, and is particularly desirable in this unit, which has a high-Q tuned circuit between the oscillator and the attenuator.

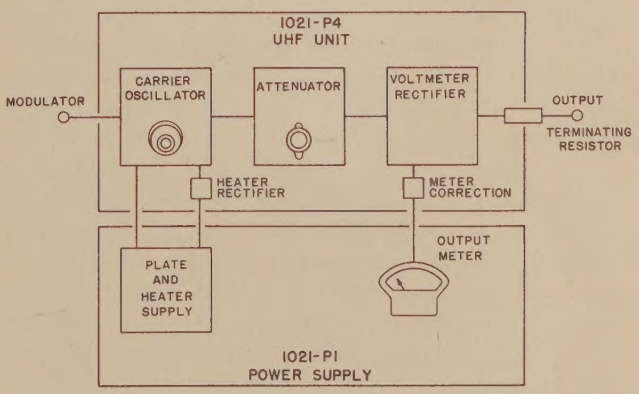

Figure 3.
Functional Block Diagram of the Type 1021-AW Standard-Signal Generator.

1.2.2 OPERATING CONTROLS.

NOTE

The panel view of the Type 1021-AW Standard-Signal Generator (Figure 1) shows the location of controls and fittings. The modulation controls and the EXT. MOD. binding posts on the front panel of the power supply are intended for sinusoidal modulation of the two lower-frequency generators, and are not used with the 900-2000 Mc high-frequency unit. The METER READS switch should always be set to CARRIER and the MODULATION switch should always be set to OFF.

1.2.2.1 Frequency Dial. The 900-2000 Mc range of the signal generator is covered in a single band at the fundamental frequency of the vacuum-tube oscillator. The frequency can be set within ± 1% on a six-inch direct-reading dial. The slow-motion dial has 100 divisions, and covers the range in about eight turns.

1.2.2.2 Attenuator Dial. The ATTENUATOR dial drives the mutual-inductance type attenuator. The dial is calibrated from 0.5 microvolt to 0.5 volt and is set to an adjustable index. This index is adjusted by a small knob directly beneath the attenuator dial, and is set when the reference level is established.

1.2.2.3 Output Terminal. The OUTPUT terminal is a Type 874 Coaxial Connector on the front panel. The output impedance is 50 ohms. Also furnished are a Type 874-R22 Patch Cord with a three-foot length of double-shielded 50-ohm polyethylene cable and a Type 874-C Cable Connector.

1.2.2.4 Panel Meter And Meter Switch. The panel meter, mounted in the power-supply unit, is controlled by the METER READS switch, just above and to the left of the meter. With the switch in the CARRIER position, the panel meter indicates (directly for voltages of 0.5 volt and over) the voltage across a crystal rectifier just ahead of the output terminating resistor.

1.2.2.5 Calibration Switch And Calibration Control. The push-button switch marked PUSH TO CAL. at the right-hand side of the carrier oscillator panel applies a calibrated voltage from the regulated heater supply to the carrier voltmeter-rectifier, and simultaneously turns off the plate supply. The CALIBRATE control knob to the right of and above the panel meter is used to adjust the meter sensitivity so that the meter reads 0.5 volt when the PUSH TO CAL. button is pushed.

1.2.2.6 Incremental Frequency Control. The Δf knob controls a small rheostat in the grid circuit of the oscillator tube and permits small frequency changes independent of the tuning control.

1.2.2.7 Modulator Input Terminal. External Modulating voltages, preferably square waves, are applied at the MODULATOR phone jack. A note above this jack states MODULATION FROM POWER SUPPLY CANNOT BE USED. The MODULATOR switch in the power supply should be set to OFF, and the METER READS switch to CARRIER.

1.2.2.8 Power ON-OFF Switch And Pilot Lamps. The power switch and the pilot lamp are mounted on the front panel. Power fuses are located inside the power supply unit on the power transformer.

1.2.3 CIRCUIT. See Figure 12 for complete wiring and schematic diagrams of the Type 1021-P4 U-H-F Unit. See Figure 11 for complete wiring and schematic diagrams of the Type 1021-P1 Power Supply. Figure 4 shows a functional diagram of the more important parts of the oscillator unit.

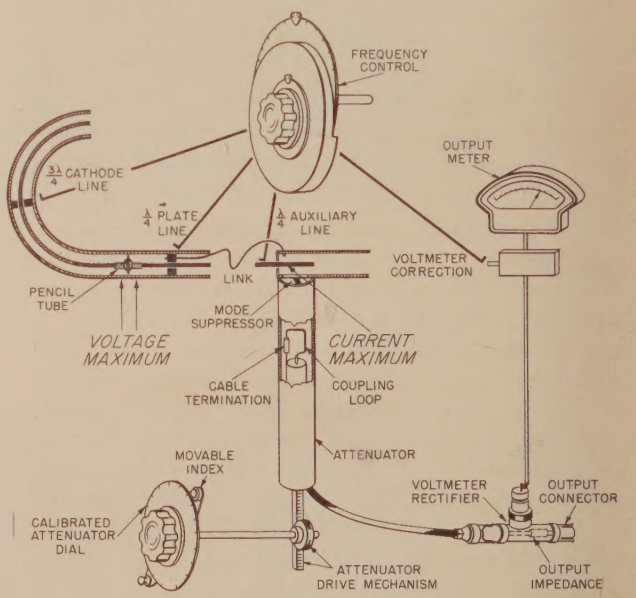

Figure 4.
Functional Diagram of Oscillator Assembly.

1.2.4 OSCILLATOR TUBE. The oscillator tube used in the Type 1021-P4 U-H-F Unit is the Type 5675 pencil triode. This tube has small internal electrodes of conventional cylindrical design, but grid connections are brought out to a large circumferential terminal that requires disk-seal construction. The cylindrical plate, grid, and cathode electrodes are all on the plate side of the grid disk, and tuning between plate and grid is possible with a quarter-wave line section at frequencies as high as 2000 Mc. At such frequencies a 3/4-wave-

length section is required for tuning between grid and cathode.

1.2.5 TUNING ELEMENTS. Since the high Q of the short coaxial grid-plate line determines the performance and stability of the oscillator, the longer grid-cathode line is coiled in a 3-1/2-in.-diameter circle and housed in a shallow cylindrical compartment to save space. (See Figure 9.) The mechanical design of the oscillator is determined by this construction, which requires a linear motion for plate tuning and a rotational motion for the cathode in a plane perpendicular to the plate line.

Of equal importance in the final design was the use of sliding contacts in the two tuned circuits. With new materials and methods available, reliable sliding contacts could be produced, and f-m noise due to vibration and microphonics is lower in contact-type circuits than in circuits that use closely spaced parts to produce wide frequency ranges.

The 1/4-in.-wide beryllium copper band and the rack and pinion visible in Figure 10 provide the linkage between the main frequency dial, which rotates 200 degrees, the short-circuit plunger of the grid-plate line, which moves 1-3/4 in., and the contact arm on the grid-cathode line, which rotates 200 degrees.

1.2.6 AUXILIARY CIRCUIT. A current maximum at all frequencies occurs only at the movable short-circuit plunger in the grid-plate quarter-wave line, and output from the oscillator is obtained by a coupling loop also located at this point. The attenuator must be coupled to an element that carries maximum current at all frequencies and is stationary in space. This is made possible by a quarter-wave line with a movable center conductor as shown in the upper part of Figure 4. This auxiliary circuit is electrically coupled to the oscillator by a link line, and the movable center conductor is joined to the movable short circuit of the oscillator. This mechanical linkage, the set screw used to adjust tracking, the link line, and the upper end of the auxiliary line are all shown in Figure 10.

1.2.7 LINK-LINE COUPLING. For mechanical reasons, the line between the oscillator plate circuit and the auxiliary circuit must be about 17 inches long. Quarter-wave resonance of this line occurs at about 100 Mc. At operating frequencies between 900 and 2000 Mc, the line is not a true link and maximums and minimums in transmissions repeat every 200 Mc. The line could have been terminated and a loss in output accepted to avoid this SWR, but instead, the line is damped by a shunt resistor and matched to generator and load, and output variations are reduced to about 2:1 over the frequency range. Actual coupling between plate circuit and auxiliary circuit depends on the frequency tracking of these two circuits and not on the geometry and position of the coupling loops of the link line alone. Before tuning elements of the plate line and the auxiliary line can be joined by the set screws "S" (see Figure 5), the tuning ranges of the two circuits must be matched. To substitute for the loading of the plate circuit by the oscillator tube, an adjustable disk is placed on the center conductor of the auxiliary circuit.

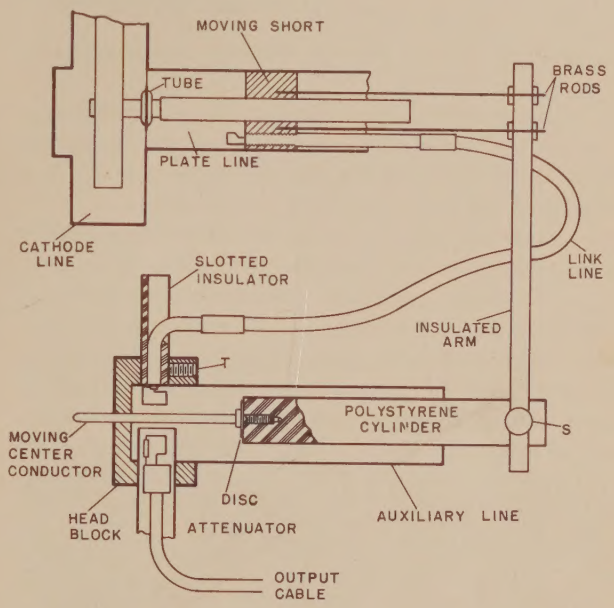

Figure 5.
Functional Diagram Showing Details of Auxiliary Line.

1.2.8 ATTENUATOR. The attenuator dial with movable index, the attenuator drive mechanism, and the attenuator tube are shown in Figure 4. A simple electrostatic shield (or mode suppressor) is mounted at the input end of the attenuator tube. so that, except for a short distance near the input end, the radio-frequency energy is attenuated at the rate of 32 db per tube diameter. The attenuator tube has an inside diameter of 3/8 inch. To attenuate one volt to 0.5 microvolt, the pickup loop must be moved about 1-1/2 inches. The attenuator dial, which drives the attenuator piston by means of a rack and pinion, is calibrated in accordance with this relation.

1.2.9 OUTPUT SYSTEM. One end of the attenuator pickup loop is grounded through a 100-ohm terminating resistor, and the other end is connected to a short length of 100-ohm flexible shielded lead. This lead is connected to the Type 874-VR Voltmeter Rectifier mounted at the lower right-hand corner of the panel.

The voltmeter unit is built into a coaxial T-section and the r-f output voltage is measured at a point just ahead of the 50-ohm cylindrical terminating resistor in the center conductor of the output connector. The rectified output of the crystal drives the output voltmeter, located on the power-supply panel.

The voltage readings on the meter and attenuator dial are open-circuit voltages. To obtain the correct value of voltage across a matched, 50-ohm load, divide the meter or attenuator dial reading by two. The voltage appearing across an arbitrary load impedance of value Z_L is $E\frac{Z_L}{Z_L + 50}$, where E is the reading of the meter or of the attenuator dial. To match a 50-ohm load and the 50-ohm terminating resistor, the resistance of the short cable leading into the attenuator and the termination of this cable is made 100 ohms.

Since the resonant frequency of the output indicator is about 4000 Mc, or twice the maximum frequency of the signal generator, a frequency correction for the voltmeter error is required. To obtain this correction, which varies from about 10 percent at 1000 Mc to 30 percent at the high end of the frequency range, R413, mounted on the rear end of the main shaft is connected across the output meter. The "additional lead" mentioned in paragraph 1.1.1 is used for this purpose. Adjustment of the potentiometer in the r-f section depends on the resonant frequency of the voltmeter rectifier used. The 500-ohm resistor R19 in the power supply is adjusted to bring the resistance of the 200-microampere panel meter to 1000 ohms, so that any r-f section will operate with any power supply.

NOTE

Some earlier models of the Type 1021-P1 Power Supply must be modified to accomodate the Type 1021-P4 U-H-F Unit. Check your Power Supply against Figure 8. If R19 is not present on your instrument, write to our Service Department, requesting Modification Kit 1021-P1-1 which will be supplied, complete with instructions, free of charge.

1.2.10 POWER SUPPLY. As mentioned in paragraph 1.2.2 NOTE, the modulation circuits of the Type 1021-P1 Power Supply are not used for the Type 1021-P4 900-2000 Mc Oscillator Unit, which can be square-wave modulated by an external source.

With the MODULATOR switch in the OFF position and with the METER READS switch in the CARRIER position, the wiring diagram is simplified considerably as shown in the elementary schematic diagram. (See Figure 11.)

Essentially constant plate and filament voltages are supplied to the carrier oscillator. The VR tube circuit (V3, V4) regulates plate voltage over a line voltage range of 105 to 125 or 210 to 250 volts at 50 to 60 cycles. The Amperite current regulator tube (V1) maintains the heater voltage for the carrier oscillator. A portion of the regulated heater voltage is used as a calibrating source for the carrier voltmeter. To reduce undesirable frequency modulation due to a-c heater power, a rectifier and filter are included in the heater circuit of the oscillator unit. To reduce plate voltage and any residual ripple in the plate supply, an additional r-c filter is included in the plate circuit of the oscillator unit.

Good regulation and low hum voltage are essential for stable operation. A one-percent change in plate voltage changes the oscillator frequency approximately 20 parts per million, and a one-percent change in heater voltage approximately 50 parts per million. The noise modulation of the Type 1021-AW Standard-Signal Generator has a peak deviation of about 4000 cycles or two parts per million. The dominant frequency component is 60 cycles. The deviation can be reduced to about 1/10 if a six-volt battery is substituted for the rectified heater supply. Small hum voltages in the plate supply do not contribute noticeably to f-m noise modulation unless a battery is used for the heater.

F-m noise modulation due to vibration and microphonics can readily be kept below the value of noise modulation due to power-line frequencies shown above.

1.2.11 MODULATION. Amplitude modulation, obtained by a-c voltages superimposed on the d-c plate voltage of the oscillator tube, introduces undesirable frequency modulation and is not used with the 900-2000 Mc r-f section of the Type 1021-P4 Standard-Signal Generator. Most of the superimposed a-c voltage that is obtained if the MODULATOR switch of the power supply is set to the 1-kc internal modulation position is eliminated by the additional r-c filter (R407, C411) mentioned in paragraph 1.2.10. However, it is recommended that the MODULATOR switch be left in the OFF position.

Square-wave modulation that turns the oscillator on and off practically eliminates frequency modulation. Ordinarily, considerable square-wave power is required to turn the oscillator off completely or to give large output if the d-c plate voltage is eliminated. To obtain satisfactory operation with low power, the circuit is changed when a plug is inserted into the modulation jack: a large resistor is added in the grid circuit, to make the oscillator unstable so that it can be modu-

lated with relatively low power. Good square-wave modulation from about 100 to 5000 cycles can be obtained, with square-wave input.

In square-wave modulation, plate current flows only half the time, and the voltage drop in the plate circuit series resistor is reduced. To prevent a rise of voltage at the oscillator tube and to prevent overloading of the VR tubes of the Power Supply, shunt resistor R417 is added when a telephone plug is inserted at the modulation jack. At the same time, the resistance of the meter circuit is reduced by shunt resistor R419 to make the meter indication correct for square-wave output.

1.2.12 FREQUENCY INCREMENTS. The Δf knob on the front panel controls a 250-ohm resistor in the grid circuit of the oscillator tube. Variation of the resistor changes the operating point of the tube and changes the operating frequency. The actual change in frequency obtained depends on grid current and feedback, which in turn depends on the tracking between the grid plate and grid cathode circuits. On any particular instrument, the frequency change varies widely with frequency. It may be positive or negative up to about 100 parts per million.

Section 2

OPERATING PROCEDURE

2.1 INSTALLATION.

2.1.1 CABINET AND POWER SUPPLY. The Type 1021-P4 U-H-F Unit (900-2000 Mc) is supplied complete with the oscillator tube in place and is ready for operation when mounted in a cabinet with the Type 1021-P1 Power Supply. Before mounting the Type 1021-P4 U-H-F Unit in a cabinet:

a. Plug the multipoint connector (permanently attached to the power supply) into the corresponding receptacle of the U-H-F unit.

b. Connect the single orange-black lead (permanently attached to the U-H-F unit to the terminal on the CALIBRATE control in the Power Supply.

Line voltage and frequency are indicated on the nameplate below the power input receptacle. The power-line-frequency range is 50 to 60 cycles. The voltage range is either 105 to 125 or 210 to 250 volts. If it is desired to change from a 105-125-volt condition to a 210-250-volt condition or vice versa, change the power transformer connections (see Figure 11), reverse the nameplate to indicate the appropriate line voltage, and replace the fuses. Fuses are mounted on the transformer terminal plate; one-ampere fuses are required for 115-volt operation and 0.5-ampere fuses for 230-volt operation.

The power supply will not operate unless an r-f oscillator is connected by means of the interconnecting cable.

2.2 FREQUENCY CONTROL. The frequency calibration, which is accurate to one percent, is spread over about 200 degrees of the main six-inch dial. Small frequency increments of the order of 20-100 kc (depending on carrier frequency) can be set on the small Δf control.

As explained in paragraph 1.2.7, good tracking of the tuned circuits and correct adjustments of various couplings are essential for proper operation of the signal generator. However, variations of the order of 2:1 should be expected to repeat every 200 Mc. In addition, some variation in output will be observed between clockwise and counterclockwise approach of some frequencies. A typical output characteristic is shown in Figure 6.

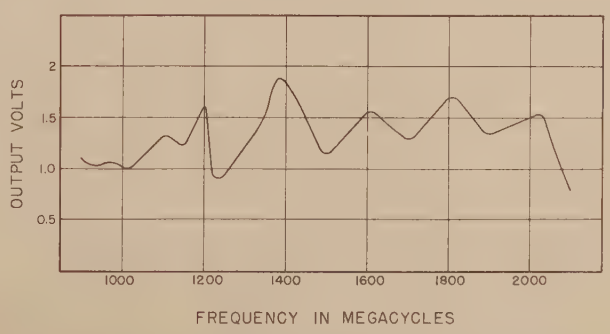

Figure 6. Typical Output Characteristics.

2.3 METER ZERO. With the power off, the meter should indicate zero. If it does not, it can be adjusted to zero by means of the screw-driver adjustment on the meter (mechanical zero adjustment). This is the only meter zeroing required, since the panel meter indicates dc from a crystal rectifier.

2.4 CARRIER VOLTMETER STANDARDIZATION. To standardize the carrier voltmeter at 0.5 volt, depress the PUSH TO CAL. switch and adjust the CALIBRATE knob until the meter reads 0.5 volt at the red line. Depressing the PUSH TO CAL. switch removes plate voltage from the carrier oscillator and applies a calibrated voltage across the voltmeter rectifier. The small effect of the 60-cycle impedance of the load can usually be neglected. The attenuator setting does not affect this procedure, but a load that generates an appreciable terminal voltage will cause the meter to deflect and will upset the meter calibration. The voltage source of such a load (e.g. a strong local oscillator of a heterodyne receiver) should be shut off during standardization.

Standardization of the carrier voltmeter should be repeated from time to time to compensate for changes in the Type 1N21-B crystal detector due to aging, overloads, or changes in temperature and humidity.

2.5 SETTING OF OUTPUT VOLTAGES BETWEEN 0.5 AND 2 VOLTS. To set output voltages between 0.5 and 2 volts directly (after carrier voltmeter has been standardized), adjust the ATTENUATOR control knob until the output meter reads the desired value with the load connected. Remember that the voltmeter indicates the voltage across the load and the 50-ohm internal terminating resistor.

Two-volt output will not be available at most frequencies. (See Figure 6.)

The voltage source of a load that generates an appreciable terminal voltage should be shut off when the meter is read.

Changes in carrier frequency and load impedance will change the output voltage and the carrier voltmeter reading. After every change restore the desired meter reading by turning the attenuator dial.

2.6 ATTENUATOR STANDARDIZATION. With the signal generator operating at the desired frequency, with the load connected, adjust the carrier output level by means of the ATTENUATOR knob until the meter reads 0.5 volt. Then move the adjustable attenuator index until it lines up with the red line at 0.5 volt on the attenuator dial. Both the meter and the attenuator dial now read 0.5 volt, and the attenuator is standardized for the particular frequency and load. The voltage source of a load that generates an appreciable terminal voltage should be shut off when the meter is read.

2.7 SETTING OF OUTPUT VOLTAGES BELOW 0.5 VOLT. To set output voltages below 0.5 volt, (after the attenuator has been standardized), turn the ATTENUATOR dial until the desired value appears under the attenuator index. As the output level decreases, the reading of the output meter gradually decreases to zero.

Changes in carrier frequency and load impedance will change the output voltage, but, at low output levels, this change cannot be observed on the output meter. After every change, the attenuator must be restandardized at 0.5 volt.

Sometimes, particularly in circuits employing tubes and rectifier crystals, the load impedance changes with the applied voltage. This change, which occurs at higher voltage levels, may make it impossible to standardize the attenuator at 0.5 volt while the voltage on the load is equally high. If this condition is suspected, the attenuator can still be standardized at 0.5 volt if additional attenuation is inserted between the signal-generator output terminal and the load. The Type 874-G20 20-db Attenuator is recommended for this purpose. Remember that the attenuator indicates the voltage across the load and the 50-ohm internal terminating resistor.

2.8 OUTPUT IMPEDANCE. As long as the attenuator is standardized for each frequency and load change, the effective output impedance of the Type 1021-A Standard-Signal Generator is 50 ohms. A constant voltage level at the reference point produces an effective impedance of zero at the output voltmeter. The output impedance of the standard-signal generator is therefore determined by the terminating resistor at the output terminal. (See Figures 3 and 4.)

2.9 MODULATION.

2.9.1 SQUARE-WAVE MODULATION. To avoid incidental frequency modulation, apply square-wave modulating voltage at the phone jack of the Type 1021-P4 U-H-F Unit. Thirty volts peak to peak with 2500 ohms internal impedance is adequate. Modulating frequencies under 100 and over 5000 cycles per second will not always give satisfactory results.

The output changes when modulation is applied. The peak output under square-wave modulation is set according to paragraphs 2.5, 2.6, and 2.7, the same way as for output without modulation.

With a plug inserted at the modulation jack and open, or with no modulation voltage applied, the output of the signal generator may be erratic.

Leave the MODULATION switch on the Power Supply in the OFF position. Do not apply external

modulating voltage at the EXT. MOD. binding posts on the Power Supply.

The small Type 1210-B Unit R-C Oscillator and a Type 1203-A Power Supply are recommended for square-wave modulation.

2.9.2 MODULATION OF SIGNAL-GENERATOR OUTPUT. For linear 100-percent amplitude modulation with negligible frequency modulation and for pulsing with short rise time and a high degree of carrier suppression, the Type 1000-P7 Balanced Modulator is recommended. This insertion-loss modulator is connected to the signal-generator output terminal. It has a modulating frequency range of 0-20 Mc. A separate source of modulating voltage is required. The maximum output into a 50-ohm load is 10 millivolts.

2.10 OUTPUT CONNECTIONS. A Type 874 Coaxial Connector is used as the output terminal on this signal generator. A Type 874-R22 three-foot Coaxial 50-ohm Patch Cord, a Type 874-C58 Cable Connector, and a Type 874-PB58 Panel Connector are supplied to facilitate transmission of the output signal to equipment under test.

Type 874 Adaptors are available for connection to systems using Types N, BNC, C, U-H-F and HN Connectors and for V-H-F 1-5/8 in. and U-H-F 3-1/8 in. Rigid Lines.

Many other Type 874 accessories are useful in extending the utility of the Type 1021-A Standard-Signal Generator in measurements of voltages, power, and standing-wave ratios.

Section 3

SERVICE AND MAINTENANCE

3.1 GENERAL. This service information, together with the information given in the foregoing sections, should enable the user to locate and correct ordinary difficulties resulting from normal use.

Major service problems should be referred to our Service Department, which will co-operate as much as possible by furnishing information and instructions as well as by supplying any replacement parts needed.

When notifying our Service Department of any difficulties in operation or service of the instrument, always mention the serial and type numbers. Also include in correspondence a complete report of trouble encountered, as well as any information concerning the use of the instrmuent and steps taken to avoid the trouble.

Before returning an instrument or parts for repair, please write to our Service Department, requesting a Returned Material Tag, which includes shipping instructions. Use of this tag will insure proper handling and identification when an instrument or parts are returned for repair. A purchase order covering repair of material returned should also be forwarded to avoid any unnecessary delay.

3.2 INPUT POWER. Power input for a Type 1021-AW Standard-Signal Generator is about 50 watts.

3.3 ACCESS TO COMPONENTS. To obtain access to the drive mechanism and heater circuit, remove the large cylindrical shield can.

CAUTION

The 210-volt regulated plate supply is connected to the grid-plate line, the 1-1/16-in. diameter tube that projects highest from the drive compartment and carries two springs with rollers on a large collar.

To obtain access to the oscillator, remove the small cylindrical shield can and the flat cover of the cast oscillator housing.

3.4 FINGER CONTACTS. When smooth frequency adjustment is no longer possible, clean the surfaces on which the finger contacts operate, using carbon tetrachloride. Lubricate the surfaces with a thin film of Lubrico and clock oil. (Lubrico MD-T-419 is manufactured by Master Lubricant Company, Philadelphia, Pennsylvania.)

For access to the contacts of the grid-cathode line, open the oscillator housing. For access to the contacts of the grid-plate line, remove the oscillator tube. (Refer to paragraph 3.5.)

3.5 REMOVING THE OSCILLATOR TUBE. The Type 5675 Oscillator Tube used in the Type 1021-P4 Unit Oscillator has no socket. The two heater leads are connected to the heater terminals by fine, short, bare wires, which are soldered to the heater terminals and wound around the heater leads. To remove the tube, unwind the wires from the heater leads. Lift out the

short extension of the cathode line at the tube end after removing the two small screws. Loosen the three screws to remove the pressure ring that holds the two tube clamp rings. When installing a tube, insert the first tube clamp ring with the fingers bent up, plug the tube into the end of the plate line and insert the second tube clamp ring with the fingers bent down. Orient heater leads radially. After installing the pressure ring and the end section of the cathode line, wrap the short wires carefully around the heater leads of the tube. If necessary, solder new wires to the terminals. Use No. 30 bare copper wires attached to the cover plate.

3.6 HEATER VOLTAGE. If the Amperite Type 6-4 heater regulator tube (V1) or the Type 5675 oscillator tube (V401) is changed, the heater voltage may require readjustment. Set rheostat R412 on the terminal strip of the oscillator unit to give 6.3-volt dc across the electrolytic capacitor C410A inside the drive compartment.

3.7 REFERENCE VOLTAGE. A 60-cycle reference voltage for checking the 0.5-volt point of the rectifier crystal is applied to the crystal when the PUSH TO CAL. switch is pressed. This switch disconnects plate voltage from the oscillator tube. The reference voltage, taken from the 60-cycle heater supply, should be correct if the heater voltage is set to 6.3 volts dc in accordance with paragraph 3.6. The reference voltage is adjusted by the voltage divider R403, but since the heater circuit includes a current regulator and a rectifier, the reference voltage is not sinusoidal and cannot be calibrated accurately. To calibrate the reference voltage:

a. Turn power off.

b. Disconnect the long shielded lead from the attenuator by unplugging the connector at the rear of the voltmeter assembly. Connect instead a sinusoidal external, accurately measured 0.5-volt 60- (or 50-) cycle calibrating voltage.

c. Press the PUSH TO CAL. switch on the oscillator unit, and set the CALIBRATE knob in the Power Supply so that the panel meter reads 0.5 volt.

d. Remove the external calibrating voltage. Plug the long shielded lead from the attenuator into the voltmeter assembly. Turn power on.

e. Press the PUSH TO CAL. switch on the oscillator unit and set voltage divider R403 on terminal strip of the oscillator unit so that the panel meter in the Power Supply reads 0.5 volt.

3.8 CRYSTAL RECTIFIER. If the carrier output meter cannot be standardized according to paragraph 2.4, the reference voltage may not be correct according to paragraph 3.7 The voltmeter diode may have been damaged and may require replacement or the circuit may be opened at the coupling loop.

The voltmeter diode is a Type 1N21-B Silicon Diode, which is mounted in the T branch of the voltmeter, immediately in back of the output terminal on the front panel. To remove the diode:

a. Disconnect the lead from the voltmeter assembly to terminal No. 8 of the PUSH TO CAL. switch by removing a small screw.

b. Remove the voltmeter filter by unscrewing the large knurled collar of the voltmeter assembly.

c. Unscrew the small spring clamp that holds the diode in place.

Any good 1N21-B crystal can be used as replacement and will give accurate results if used in accordance with paragraphs 2.4, 2.6, and 2.7 for output voltages below 0.5 volt. Back resistance, measured with a 1.5-volt source, should be over 10,000 ohms. For accurate output voltages between 0.5 and 2 volts in accordance with paragraph 2.5, the crystal characteristic must match the meter scale. Selected crystals that conform to the original accuracy specifications of the Signal Generator can be obtained from the General Radio Company. If desired, any 1N21-B crystal can be checked between 0.5 and 2 volts by the following procedure:

a. Turn power off.

b. Disconnect the long shielded lead from the attenuator by unplugging the connector at the rear of the voltmeter assembly. Connect instead an external 60- (or 50-) cycle calibrating voltage in parallel with an accurate voltmeter.

c. Set external voltage to 0.5 volt. Press the PUSH TO CAL. switch on the oscillator unit and set the CALIBRATE knob on the power supply so that the panel meter reads 0.5 volt.

d. Set external voltage to values up to two volts and note readings of the panel meter.

3.9 VOLTMETER FREQUENCY CORRECTION. Rheostat R413, mounted on the rear end of the main shaft, compensates for the frequency characteristic of the diode voltmeter, which has a resonant frequency of about 4000 Mc. The actual resonant frequency, which may vary by 10 percent, depends on the individual Type 1N21-B diodes. If the diode has been changed, the arm of the compensating rheostat may have to be reset to make the output meter indicate correctly. To do this, a power meter accurate at the high end of the frequency range and accurately matched to 50 ohms is needed.

a. Check reference voltage according to paragraph 3.7.

b. Standardize output meter according to paragraph 2.4.

c. Measure output power at high end of frequency range and adjust attenuator to make measured power 1.25 milliwatts.

d. Loosen the two set screws that hold arm of compensating rheostat at rear end of main shaft and adjust arm to make output meter read 0.5 volt. Tighten the two set screws.

If an accurate power meter is not available, the compensating rheostat R413 should be set to compensate for a diode of average resonant frequency of 4000 Mc. The meter correction at an oscillator frequency of 2000 Mc is then $1 - \left(\frac{2000}{4000}\right)^2 = 0.75$. Corresponding correction factors for resonant frequencies of 3600 and 4400 Mc are 0.69 and 0.79. To set the compensating rheostat for average correction:

a. Open lead from compensating rheostat to power supply.

b. Set Signal Generator to 2000 Mc, 1 volt.

c. Restore lead from compensating rheostat. Loosen the two set screws that hold arm of rheostat and adjust arm to make output meter read 0.75 volt. Tighten the two set screws.

3.10 ADJUSTMENTS. As mentioned in paragraph 1.2.7, considerable output variation must be expected over the frequency range. To obtain an output characteristic similar to the typical curve drawn in Figure 6, many interdependent adjustments must be made in proper sequence. The complicated procedure should not be attempted by an inexperienced operator. In the following paragraph it is assumed that the oscillator has been operating properly and that only minor adjustments are required. A brief outline to help a skilled technician in a complete alignment is given in paragraph 3.16.

As indicated in Figure 6, output meter readings near 1 volt should be obtained at all frequencies with a matched load of 50 ohms. To be able to standardize the attenuator, at least 0.5 volt is required at the output meter, which corresponds to 0.25 volt across the 50-ohm load.

While the oscillator tube is the only component whose life has a definite limit, tube failure is not the only cause of unsatisfactory output. With a good tube, the oscillator may not be working due to poor tracking of the cathode-grid circuit, and with the oscillator working properly, output might be low or zero at some frequencies due to poor tracking or coupling of the auxiliary circuit.

If the output is low at some frequencies, always check ganging adjustment first. (Refer to paragraph 3.13.2.) Since tube replacement may require extensive readjustment, measure grid and plate current to make sure that a new tube is required. The regulated plate voltage delivered by the power supply is 210 volts. The plate voltage at the oscillator tube, measured after the 3900-ohm plate series resistor R407 varies with frequency and should be about 150 volts.

3.11 OSCILLATOR TUBE.

3.11.1 GENERAL. The oscillator tube is a Type 5675 U-H-F Medium-Mu Triode of pencil-type construction. These tubes are available from several manufacturers. Experience has shown that, while most tubes can be used in the Type 1021-P4 Oscillator, tubes of the same make agree more closely in frequency calibration. Tubes of different manufacture may differ by several percent at the high-frequency end of the range. Small discrepancies can be minimized by realignment of the calibrated dial, but best results are assured by a tube of the same make as the tube it replaces.

3.11.2 GRID CURRENT. In normal operation, grid current varies from 6 ma at low frequencies to 1 ma at 2000 Mc. Measure the grid current by inserting a meter at filter LC404, the lowest of the three filters at the right side of the main casting.

If the grid current is normal, the tube is good and the oscillator is properly adjusted, but the auxiliary circuit may need adjustment. If the grid current is low or zero at some frequencies, measure the plate current.

3.11.3 PLATE CURRENT. In normal operation, plate current does not vary much over the entire frequency range and should be from 15 to 25 ma. Measure plate current by inserting a meter at filter LC402, the uppermost of three filters at the right side of the main casting. If the plate current is low with low or zero grid current, replace the tube. If the plate current is high with low or zero grid current, the oscillator circuit may need adjustment.

3.12 OSCILLATOR TRACKING.

3.12.1 GENERAL. Tracking between plate and cathode circuits depends on the relative position of two tuning elements, which are ganged by a 1/4-in. beryllium copper band. This band is coiled on two pulleys, and tension is maintained by a cord that runs over a small third pulley. The diameters of the two larger pulleys determine the relative motion of the tuning elements. These diameters are fixed, but a small adjustment is provided at both ends of the frequency range.

Tracking of the grid-cathode line might be disturbed by slipping of a set screw, by stretching of the 1/4-in. beryllium copper band or by breaking of the nylon cord that keeps the band under tension.

To check tracking, follow the procedure given in paragraph 3.16. Except for obvious difficulties (e.g. a loose set screw or a broken band), no quick and simple adjustment should be expected to improve operation.

As explained in paragraph 3.16, tracking of a completed instrument can be checked only at key frequencies, which are approximately at every odd multiple of 100 Mc. To check tracking of the cathode line continuously over the frequency range, reduce coupling to the link line by rotating the link line 90 degrees or by removing it altogether. (Refer to paragraph 3.14.2.)

To check tracking, loosen the two set screws of the large insulating pulley with a 3/32 Allen wrench to see if higher output can be obtained by readjustment. For convenience, turn the pulley on its shaft, using the Allen wrench as lever. Turning the pulley changes the tuning of the cathode line. At low frequencies, only one position of the cathode tuning will give output and grid current. At high frequencies, three positions will be found, but obviously only one of these can be used. After any adjustment, be sure to tighten all set screws.

3.12.2 TRACKING AT HIGH FREQUENCIES. Output at high frequencies is improved by adjustment of an arm that interferes with the beryllium band and causes the cathode tuning to move faster. This arm is mounted on the metal ring that rides on the large insulating pulley on the main drive shaft. To adjust the arm, rotate the metal ring on the large pulley. The arm should contact the beryllium band soon after 1800 Mc and should be adjusted for best output near 2000 Mc. Oscillations beyond 2000 Mc are sometimes critically affected by the position of the arm.

3.12.3 TRACKING AT LOW FREQUENCIES. Output at low frequencies is improved by adjustment of an arm that interferes with the beryllium band and causes the cathode tuning to move slower. This arm is mounted on the metal ring that rides on the cathode tuning shaft. To adjust the arm, rotate the metal ring. The arm should contact the band near 1000 Mc and should be adjusted for best output near 950 Mc.

Output near 900 Mc can be adjusted in addition by a 6/32 brass screw, through the side of the cast oscillator housing. This screw, located between two pairs of nylon screws, is secured by a locknut. Do not use this adjustment beyond the point where grid current exceeds 8 ma.

3.13 TRACKING OF THE AUXILIARY CIRCUIT.

3.13.1 GENERAL. Tracking of the auxiliary line is determined by the adjustments shown schematically in Figure 5.

The moving short of the plate grid line and the moving center conductor of the auxiliary line are connected mechanically by two brass rods, an insulated arm, and a large polystyrene cylinder. Their relative position is determined by set screw "S", which is also shown in Figure 5.

The tuning range of the auxiliary line is determined by the position of a disk on the moving center conductor.

3.13.2 GANGING ADJUSTMENT. Proper adjustment of ganging, as determined by set screw "S" (Figure 5), is very important and should always be checked if output at the low points of the output curve (compare with Figure 6) is below the acceptable minimum.

Friction of the moving center conductor may cause backlash and a lag in tuning of the auxiliary line, which is very noticeable if the main tuning dial is reversed. In that case, output of the signal generator at any one frequency will depend on the direction from which this particular point is approached.

Before adjusting the position of the center conductor by set screw "S" (Figure 5) note the present position of the polystyrene cylinder with respect to the insulated arm, and plot output against frequency. (See Figure 6.)

a. Loosen set screw "S" and make sure the center conductor moves freely. Clean contacts if required.

b. Adjust the center conductor for maximum output at one of the low points near the high-frequency end. Tighten the set screw. Check the output over the frequency range.

c. Repeat adjustment until best compromise is obtained. Make small changes only. Plot output against frequency.

3.13.3 RANGE ADJUSTMENT. Adjustment of the tuning range of the auxiliary circuit by moving the disk should not be required unless the oscillator tube has been changed, and even then only a very slight adjustment may be required. The disk is clamped between the polystyrene cylinder and a check nut. Do not change the position of the disk unless you are prepared to follow instructions of paragraph 3.16, written for a skilled technician.

a. Remove the polystyrene cylinder and the center conductor and accurately measure length of conductor projecting.

b. Change the position of the disk by one quarter of a turn of threads at a time. Loosen the check nut. Screw the center conductor in or out of the polystyrene cylinder. Tighten the check nut.

3.13.4 HIGH-FREQUENCY CORRECTION. In addition to the two adjustments mentioned above, there is a third tracking adjustment, which will hardly ever have to be made. It consists of a slotted brass tube inserted in the auxiliary line and adjusted to compensate for the presence of the attenuator tube at the high-frequency end of the range, when the disk end of the moving center conductor is in the lowest position.

3.14 LINK LINE.

3.14.1 GENERAL. One end of the link line is coupled to the moving short of the tuned plate line, the other end is stationary. Between the ends, the link line forms a loop that assumes different positions depending on frequency. A spring clip holds the loop in place near the end where it emerges from the plate line and keeps it from turning. The other end of the line is held in a slotted insulating tube and clamped in position in the head block of the auxiliary line, opposite the attenuator tube. Insulation is required since the link line is screwed directly into the moving short of the plate line. The insulating tube is accessible through an opening in the main casting near the PUSH TO CAL. switch. The hole is covered by a round plate held by small screws. The set screw "T", (Figure 5) in the head block of the auxiliary line, is accessible from the top of the drive compartment. This screw clamps the link line.

3.14.2 PLATE COUPLING. The plate end of the link line is screwed into the moving short and should project 3/16 in. into the plate compartment. This projection corresponds to about nine turns. The plane of the loop, which corresponds to the red dot on top of the line housing, should be oriented radially. Projection of the loop can be measured when the oscillator tube is removed. To thread the link line in and out of the moving short, the far end of the line must be removed from the head block of the auxiliary line and must be free to rotate. Secure the loop of the link line by means of the spring wire.

3.14.3 AUXILIARY LINE COUPLING. The other end of the link line ends in an L and is covered by a slotted insulating tube. This end is clamped in the head block of the auxiliary line, and should come to within 3/16 in. of the moving center conductor. The plane of the loop should be parallel to the center conductor. The position of the coupling loop can be observed from the top through the auxiliary line after the polystyrene tube has been removed. A small variation of the coupling may improve the output at the highest frequencies. After adjustment, secure the end of the link line by the set screw "T" (Figure 5).

3.15 LUBRICATION. In addition to the care of the finger contacts described in paragraph 3.4, some lubrication of other moving parts is required. The main drive shaft and the shaft of the cathode line tuner have ball bearings and do not require frequent attention, but the rack and pinion drive of the plate tuner, and the gears of the precision drive on the front panel should be inspected and lubricated from time to time. The two small rolls that press the rack against the pinion, and the small idler pulleys should always move freely when frequency is changed.

3.16 ALIGNMENT.

NOTE

The following alignment procedure is intended for the skilled technician only. Before attempting alignment, read the following paragraphs, satisfying yourself that you can make all required measurements and adjustments.

3.16.1 GENERAL. If proper output cannot be obtained by following the suggestions of the preceding paragraphs and by making adjustments, one at a time, as indicated, a complete alignment of the standard-signal generator by a skilled technician may be required. The same procedure may have to be followed after replacement of the oscillator tube, but in general, only minor adjustments will be required after installing a new tube.

3.16.2 KEY FREQUENCIES. As pointed out in paragraph 1.2.7, resonance of the unterminated line between the auxiliary circuit and the plate circuit causes periodic variations in transmission of power to the output circuit. The line, which is much too long to act as a true link line, has a quarter-wave resonance slightly over 100 Mc. It is nonreactive and practically a short, therefore, at all frequencies that are odd multiples of 100 Mc, and nonreactive and an open circuit at all frequencies that are even multiples of 100 Mc. At all other frequencies the line is reactive.

Matched to generator and load, the line would have no effect at any frequency, but if the match is not perfect, the effect of the line is still small at multiples of its quarter-wave resonance.

It is very important, therefore, to make all circuit adjustments at these unique key frequencies, which are readily found if the oscillator is working.

Remove the center conductor from the auxiliary circuit and measure the grid current over the range. Grid current will dip sharply or come to zero at all odd multiples of resonance. These key frequencies vary between instruments but will be near 1080, 1300, 1520, 1740 and 1960 Mc. Note the exact location of key frequencies in terms of vernier-dial divisions.

3.16.3 OSCILLATOR ADJUSTMENTS. If the oscillator is not working properly, measure the plate and grid current and check tracking. To do this, reduce coupling to the link line by rotating the line or by re-

moving it altogether. The red dot on the top of the link-line sleeve indicates orientation of the coupling loop. Follow instructions given in paragraphs 3.10, 3.11, and 3.12. Correction of tracking at low frequencies is not required until later.

3.16.4 SEQUENCE OF ALIGNMENT. With the oscillator working properly, and with the key frequencies determined, the following sequence of adjustments is suggested to avoid as much as possible the annoyance of interdependent adjustments. Consult the preceding sections for a more detailed discussion of various adjustments.

a. Couple the link line at the moving short in the plate line and set penetration to 3/16 in. (Refer to paragraph 3.14.2.)

b. Couple the link line to the auxiliary line. (Refer to paragraph 3.14.3.)

c. Set the attenuator to its highest output.

d. Set the oscillator accurately to the key frequency near 1740 Mc.

e. Tune the auxiliary line, and clamp the set screw "S" (Figure 5).

f. Set the oscillator accurately to the key frequency near 1080 Mc.

g. Note if the auxiliary line is tuned accurately by loosening the set screw "S" and retuning the line. If the tuning was accurate, the auxiliary line tracking is correct. If not correct, adjust the disk on the center conductor. (Refer to paragraph 3.13.3.)

h. Move the disk nearer to the threaded end if the center conductor was too short at low frequency. Move the disk away from the end if the center conductor was too long at low frequency.

i. Repeat disk adjustments (steps d, e, f, g, h) until good tracking at all frequencies is obtained.

j. Adjust ganging for best output over entire range. (Refer to paragraph 3.13.2). Making this adjustwill reduce the output at some frequencies, but will improve the average and should be used particularly to avoid points of low output. Special adjustments are provided to avoid low output at both ends of the frequency range.

k. Improve output at high frequencies by adjusting the arm that interferes with the beryllium band. (Refer to paragraph 3.12.2.)

l. Improve output at low frequencies by adjusting the arm that interferes with the beryllium band. (Refer to paragraph 3.12.3.)

m. Improve output near 900 Mc by adjusting the screw at the side of the oscillator housing. (Refer to paragraph 3.12.3.)

n. Repeat adjustment of ganging (step j).

o. Improve output by link-line coupling to auxiliary line. (Refer to paragraph 3.14.3.)

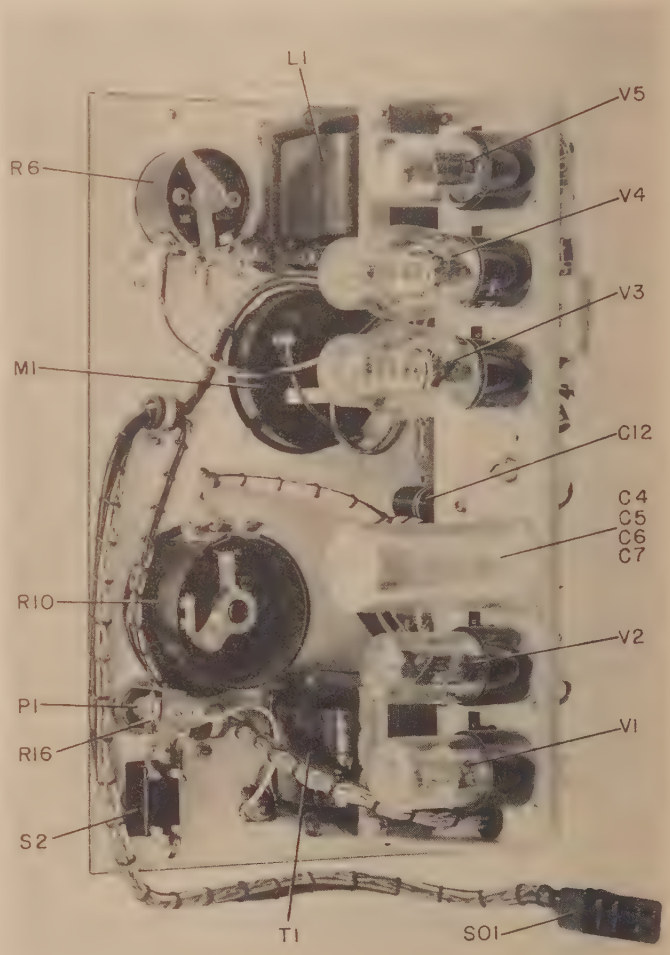

Figure 7. Interior View, Type 1021-P1 Power Supply

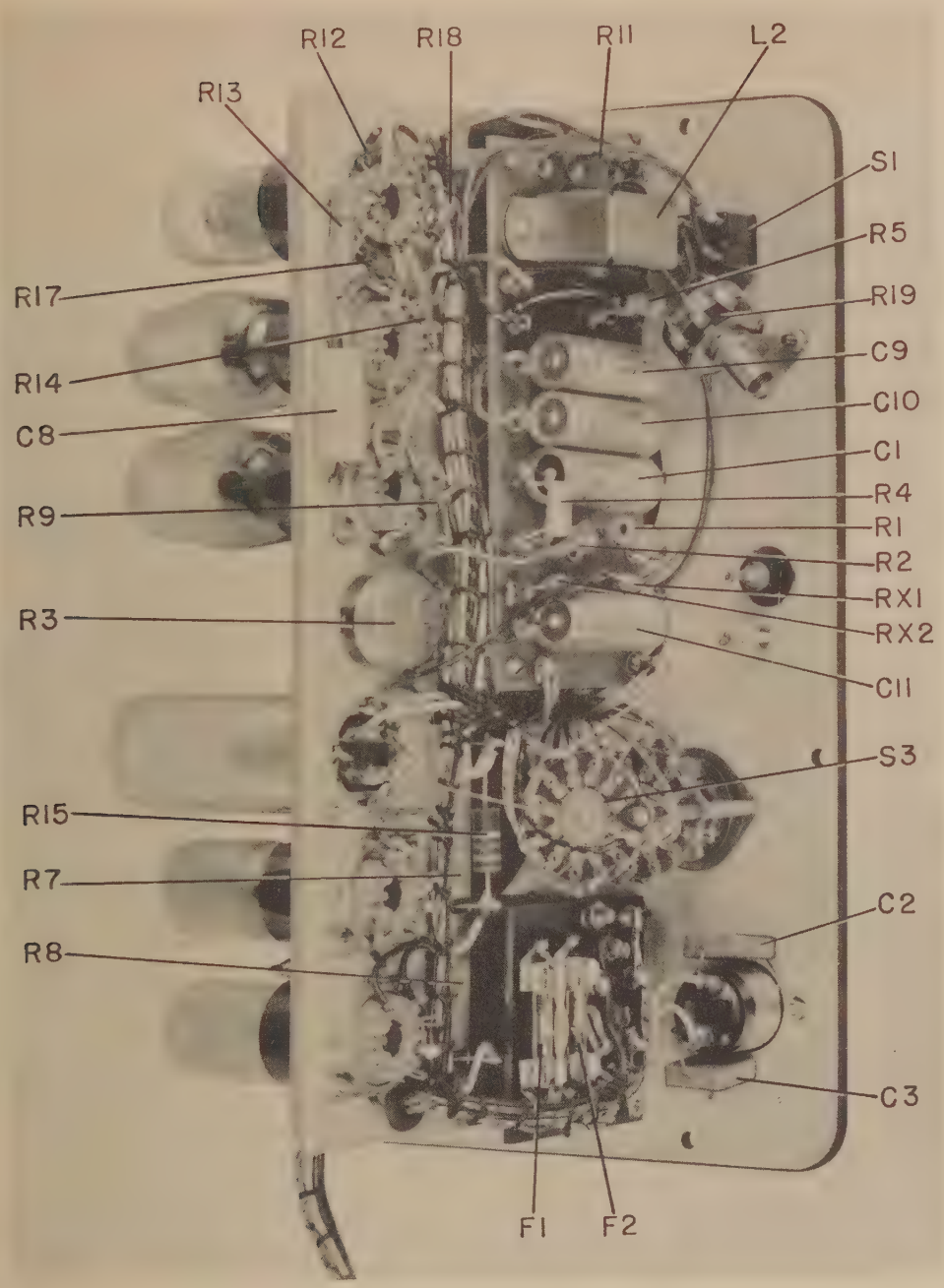

Figure 8. Interior View, Type 1021-P1 Power Supply

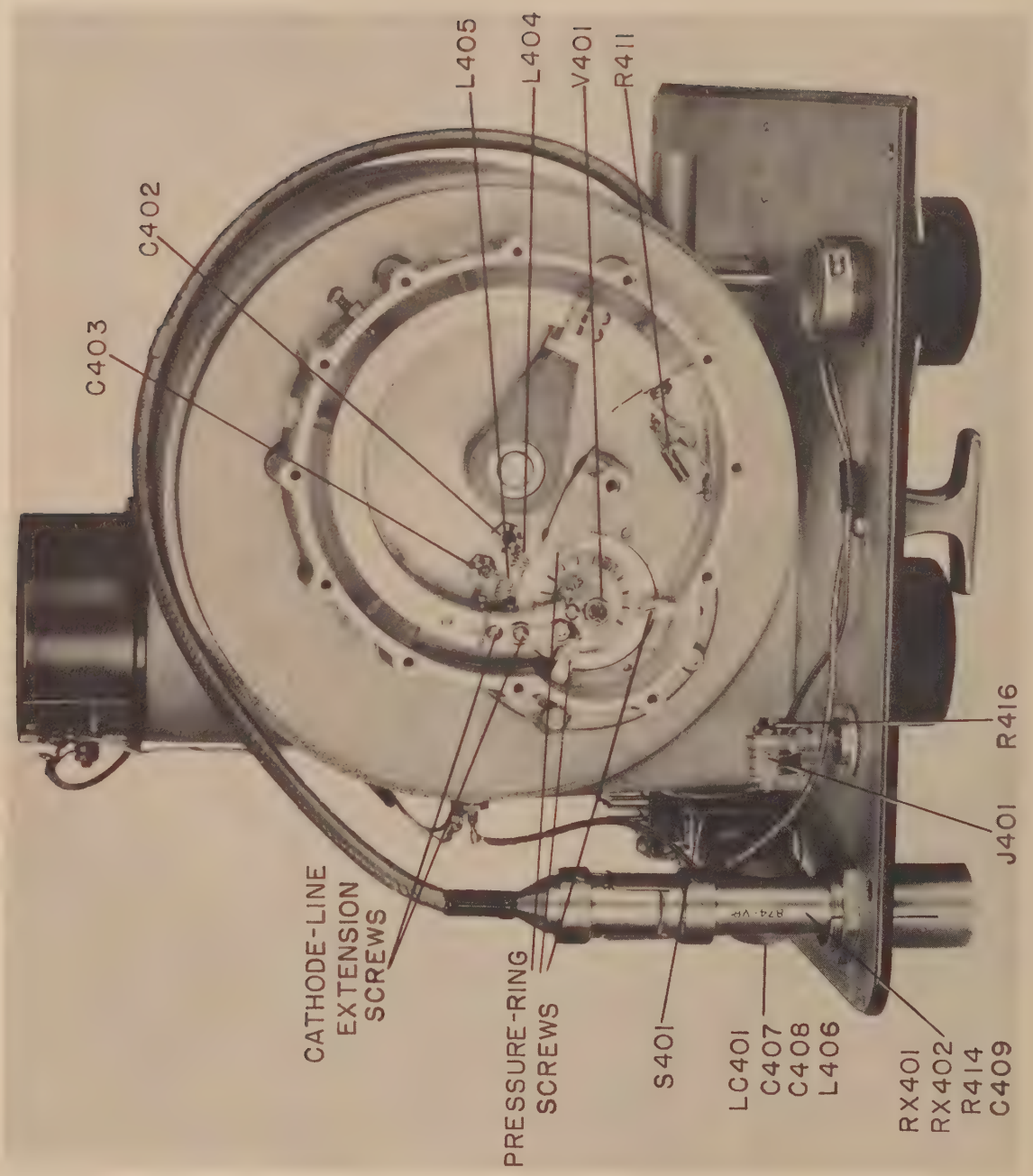

Figure 9. Oscillator Assembly, Showing Cathode Line

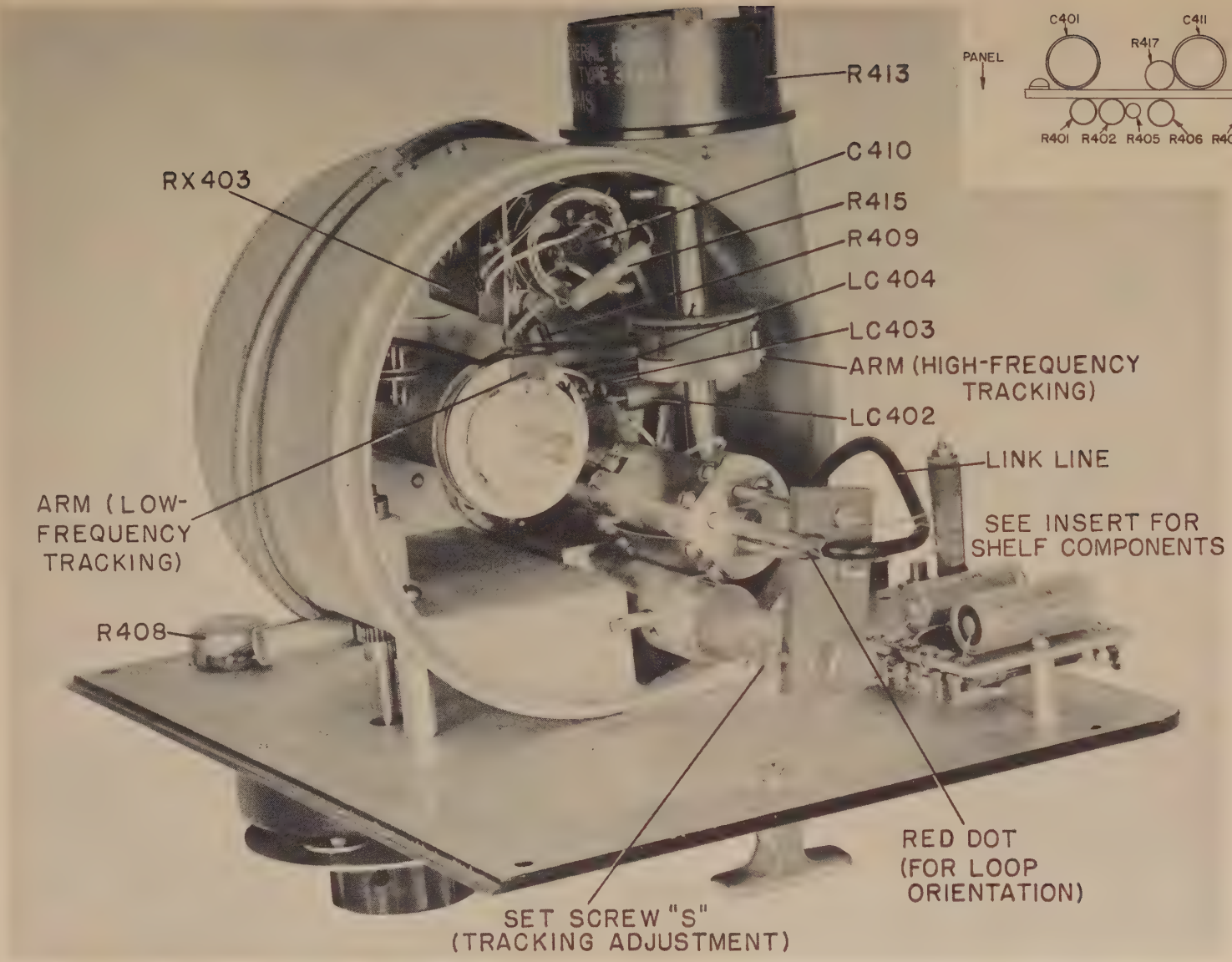

Figure 10. Oscillator Assembly, Showing Drive Mechanism

Section 4
PARTS LIST

						GR No. (NOTE A)
TYPE 1021-P1 POWER SUPPLY						
RESISTORS (NOTE B)	R1	33 k	±5%	½w		REF-1
	R2	33 k	±5%	½w		REF-1
	R3	2.5 k	±10%			POSW-3
	R4	100 k	±5%	½w		REF-1
	R5	5.6 k	±10%	½w		REF-1
	R6	10 k	±5%			301-A
	R7	900	±10%			REPO-33
	R8	900	±10%			
	R9	100	±10%	½w		REW-3C
	R10	100 k	±5%			314-A
	R11	330	±5%	½w		REW-3C
	R12	270	±5%	½w		REW-3C
	R13	750.	±5%	1w		REW-4C
	R14	1 M	±10%	½w		REC-20BF
	R15	1.8 k	±10%	2w		REC-41BF
	R16	15	±10%	½w		REW-3C
	R17	180	±10%	½w		REW-3C
	R18	180	±10%	½w		REW-3C
	R19	500	±10%			POSW-3
CAPACITORS (NOTE C)	C1	0.15	±10%	600 dcwv		COL-57
	C2	0.01	±10%			COM-35B
	C3	0.01	±10%			COM-35B
	C4	20	450 dcwv			
	C5	20	450 dcwv			COEB-25
	C6	20	450 dcwv			
	C7	20	450 dcwv			
	C8	0.02	±10%	1000 dcwv		COL-33
	C9	0.15	±5%	600 dcwv		COL-57
	C10	0.15	±10%	600 dcwv		COL-57
	C11	0.15	±10%	600 dcwv		COL-57
	C12	0.1	±10%	600 dcwv		COL-71
MISCELLANEOUS	F1	Fuse (for 115v), 0.5 amp Slo-Blo 3AG				FUF-1
	F1	Fuse (for 230v), 1 amp Slo-Blo 3AG				FUF-1
	F2	Fuse (for 115v), 0.5 amp Slo-Blo 3AG				FUF-1
	F2	Fuse (for 230v), 1 amp Slo-Blo 3AG				FUF-1
	L1	Choke				485-458
MISCELLANEOUS	L2	Coil, Oscillator				746-412
	M1	Meter, 200μa, 600Ω				MEDS-40
	P1	Pilot Light				2LAP-939
	PL1	Plug, Power				CDPP-562A
	RX1	Rectifier				1N34-A
	RX2	Rectifier				1N34-A
	S1	Switch, dpdt				SWT-335
	S2	Switch, dpst				SWT-333
	S3	Switch, 8-pole 3-position				SWRW-50
	SO1	Socket, 8-blade				CDMS-1-8
	T1	Transformer				485-459
TYPE 1021-P4 U-H-F UNIT.						
	R401	5.1 k	±5%	2w		REW-6C
	R402	5.1 k	±5%	2w		REW-6C
	R403	5	±10%			POSW-3
	R404	4.7	±10%	½w		REW-3C
	R405	91	±5%	½w		REW-3C
	R406	20	±5%	2w		REW-6C
	R407	3.3 k	±5%	5w		REPO-43
	R408	250	±10%			POSC-7
	R409	680	±5%	½w		REC-20BF
	R410	100	±1%	1/4w		REF-2-4
	R411	75	±5%	½w		REC-20BF
	R412	10	±10%			POSW-3
	R413	20 k	±5%			314-412
	R414	50	±1%			REU-10-2
	R415	3.3	±10%	1w		REW-4C
	R416	10 k	±10%	½w		REC-20BF
	R417	15 k	±10%	5w		REPO-43
	R418	65	±5%			REF-2-5
	R419	33 k	±5%			REC-20BF
CAPACITORS (NOTE C)	C401	16	150 dcwv			COE-4
	C402	27μμf	±20%	500 dcwv		COC-3
	C403	27μμf	±20%	500 dcwv		COC-3
	C404	Built in				
	C405	Built in				
	C406	Built in				
	C407	1000 μμf				1021-214
	C408	1000 μμf				COU-25
	C409	300-400 μμf				Part of RX-401
	C410A	1500				
	C410B	750	10 dcwv			COE-9
	C410C	750				
	C411	10	250 dcwv			COE-
	C412	4	150 dcwv			COE-50

			GR No. (NOTE A)				GR No. (NOTE A)
MISCELLANEOUS	J401	Jack, Modulation	CDSJ-18	MISCELLANEOUS	LC402	Filter	1218-203
	L401	Inductor	1218-94		LC403	Filter	1218-203
	L402	Inductor	1021-P4-90		LC404	Filter	1218-203
	L403	Inductor	1021-P4-201		PL401	Plug	CDMP-1264-8
	L404	Inductor	1213-803		RX401	Rectifier, Voltmeter	874-309
	L405	Inductor	1213-803		RX402	Rectifier	1N21-B
	L406	Inductor 2μh	ZCHA-37		RX403	Rectifier	2RE-18
	LC401	Filter	1021-302		S401	Switch	SWP-18

NOTES

(A) Type designations for resistors and capacitors

COC - Capacitor, ceramic
COE - Capacitor, electrolytic
COEB - Capacitor, electrolytic block
COL - Capacitor, oil
COM - Capacitor, mica
COU - Capacitor, unclassified
POSC - Resistor, variable, composition
POSW - Resistor, variable, wire-wound
REC - Resistor, fixed, composition
REF - Resistor, fixed, film
REPO - Resistor, fixed, power
REU - Resistor, fixed, unclassified
REW - Resistor, fixed, wire-wound

(B) All resistances are in ohms, except as otherwise indicated by k (kilohms) or M (megohms).

(C) All capacitances are in microfarads, except as otherwise indicated by $\mu\mu$f (micromicrofarads).

(D) R414, C409, and RX402 are parts of RX401. C407, C408, and L406 are parts of LC401.

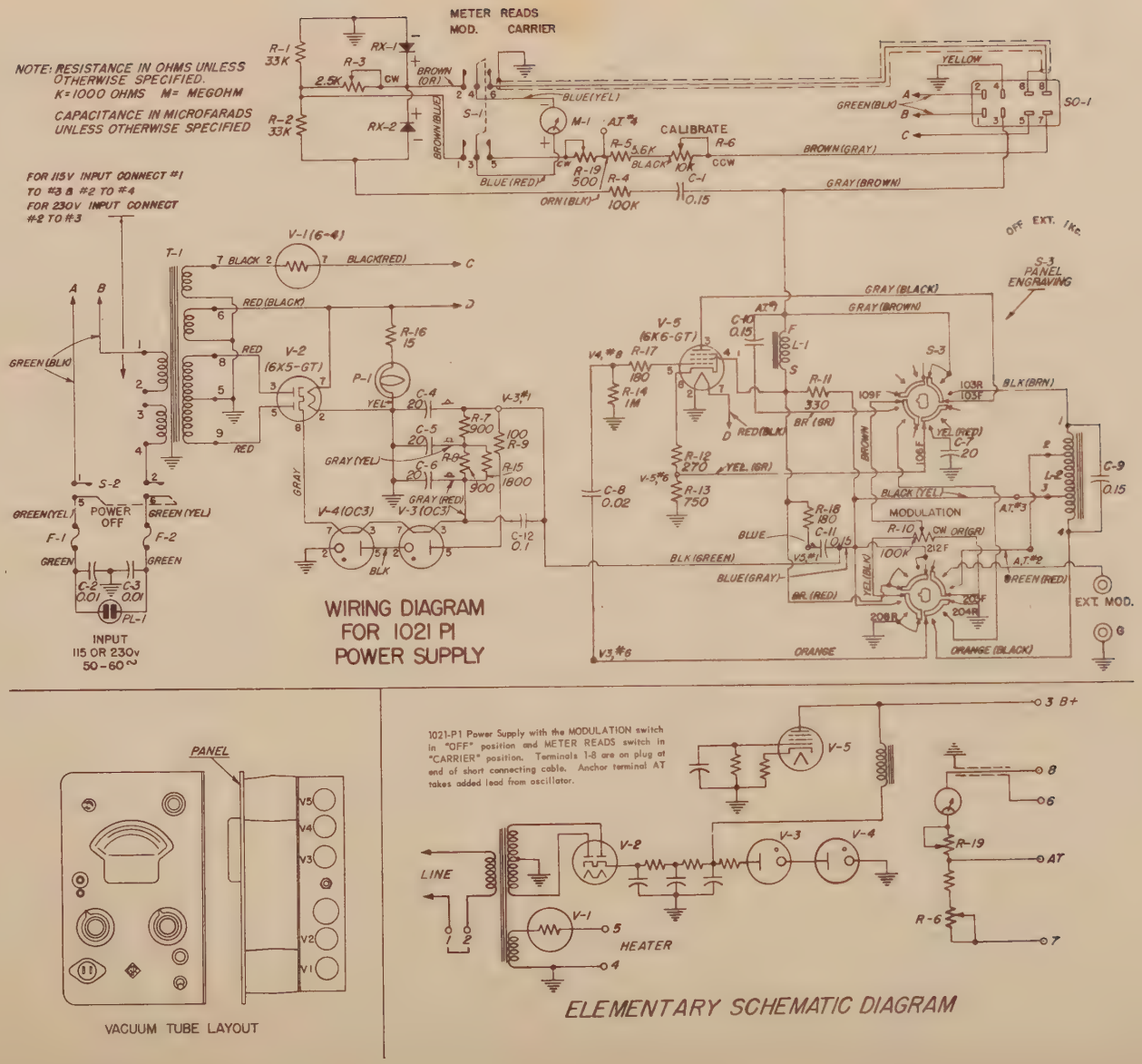
METER READS
MOD. CARRIER
NOTE: RESISTANCE IN OHMS UNLESS OTHERWISE SPECIFIED. K=1000 OHMS M= MEGOHM
CAPACITANCE IN MICROFARADS UNLESS OTHERWISE SPECIFIED
FOR 115V INPUT CONNECT #1 TO #3 & #2 TO #4
FOR 230V INPUT CONNECT #2 TO #3
INPUT 115 OR 230v 50-60~
POWER OFF
CALIBRATE
MODULATION
EXT. MOD.
S-3 PANEL ENGRAVING
WIRING DIAGRAM FOR 1021 P1 POWER SUPPLY
PANEL
VACUUM TUBE LAYOUT
1021-P1 Power Supply with the MODULATION switch in "OFF" position and METER READS switch in "CARRIER" position. Terminals 1-8 are on plug at end of short connecting cable. Anchor terminal AT takes added lead from oscillator.
LINE
HEATER
ELEMENTARY SCHEMATIC DIAGRAM

Figure 11. Schematic Diagram, Type 1021-P1 Power Supply

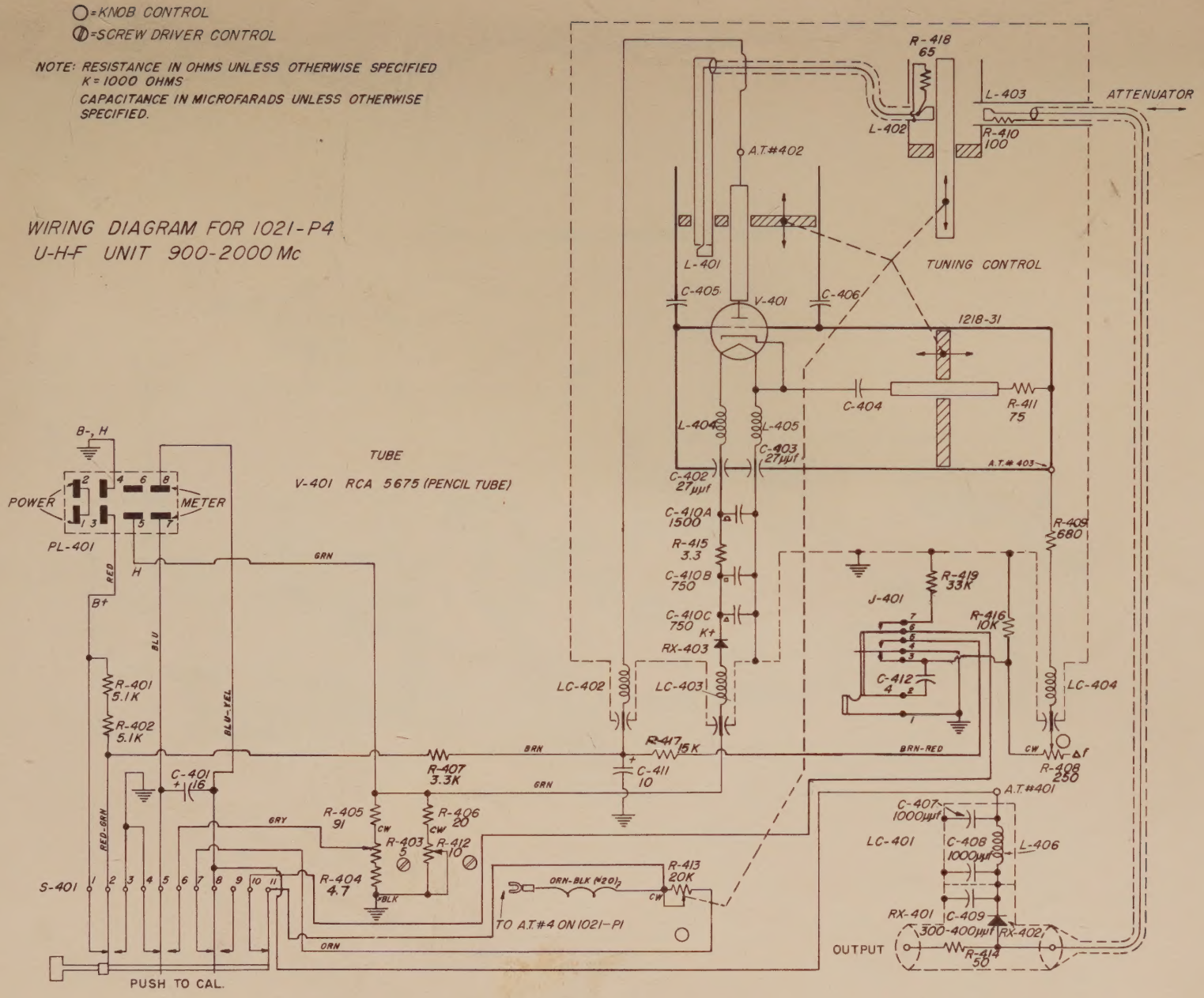

Figure 12. Schematic Diagram, Type 1021-P4 U-H-F Unit

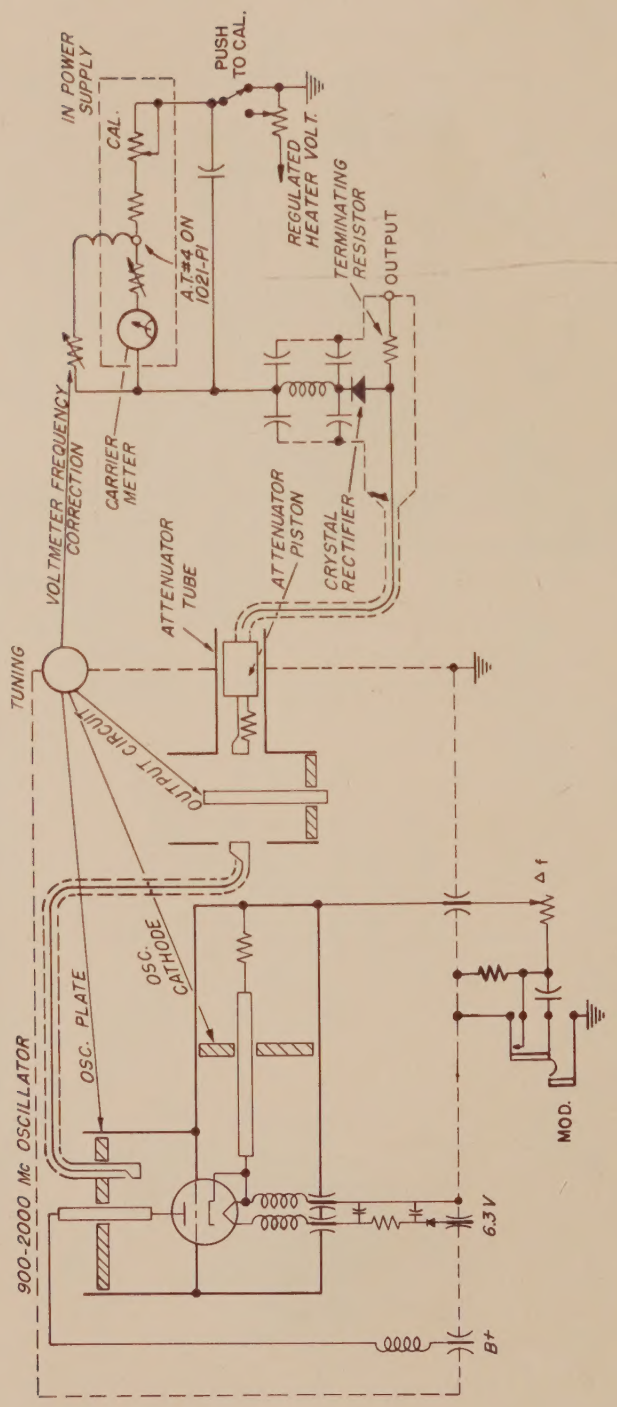

Figure 13. Elementary Schematic Diagram.